March 29, 1960

Dr. John A. O'Keefe
Theoretical Division
Goddard Space Flight Center
8719 Colesville Road
Silver Spring, Maryland

Dear Dr. O'Keefe:

Thank you for your letter of March 11th. I would certainly be very enthusiastic about following up the approaches suggested in your letter. We have already discussed some similar projects but I do not believe any of them is being actively studied. The survivorship of bacteria in chemical explosions has been studied by the Biological Warfare Laboratories at Fort Detrick and it might be worthwhile to consult Dr. Charles Phillips there for current information that might relate to your suggestion. There is another possible hazard to small particles of certain sizes that likewise deserves further investigation. This would be the Tabor Effect which would apply to particles of approximately micron size. Werner Suomi believes that such particles would have great difficulty in re-irradiating at infrared wave lengths larger than their own dimensions. However, they could still efficiently absorb at lower wave lenghts. Consequently, their equilibrium temperatures might be very high indeed. Smaller particles would be exposed to the shorter ultraviolet and the corpuscular radiation without shielding and be destroyed by these. If these arguments are true the smallest effective vehicle for surviving organisms would have to be at least several microns in diameter. Is the Tabor Effect well enough understood that its application to the present case would be entirely straightforward?

Your suggestion, the frequency of microorganisms at high altitudes, is an extremely important one on many counts. Believe it or not, we have no really useful data on the frequency at altitudes above about 30,000 feet! There are many reasons why the detailed profile of bacteria-bearing dust should be intensively studied. At one time there were strong arguments to doubt that such particles could be carried above the tropopause but now that turbulence, even in the ionosphere, is a more respectable concept the whole question should perhaps be reinvestigated. Certainly bacteria should be among the most reliable indices of terrestrial origin. At very high altitudes efforts should be made to collect micrometeorites on sterile filters and on non-carbonaceous filters in order to establish the incidence of 1) microorganisms, and 2) particles comprised of carbon, nitrogen etc. which should be abundant among meteoroids of cometary origin.

These experiments would quite appropriately relate to probes on balloons, rockets and recoverable satellites in order to sample various altitudes. Once again the Biological Warfare Laboratories should have both the interest and experience to tie into such a program. I will be very happy to lend any possible assistance to this.

In principle your third suggestion is equally promising. However, the difficulty with studying any object that has reached the earth's surface is the uncertainty whether it may be contaminated by terrestrial materials. A level of contamination that would be chemically insignificant could make the investigation worthless from a biological point of view. However, I certainly agree that all such objects should be carefully analysed not only for their mineral constituents but also for the carbonaceous compounds which have been all but ignored in past studies. Calvin's recent findings on carbonaceous chondrites are most exciting.

We have learned absolutely nothing about the Russian program in exobiology except the bare statements, of which you must already be aware, that they are taking due precautions. I do not think that decontamination presents any serious fundamental problems; of course a successful program does require a sincere concern for the problem and a consequent willingness to take some pains in the treatment and handling of the payloads. While a formidable effort may therefore be necessary, it should still be relatively insignificant compared to the goals at stake and to the other effort that goes into the development of the vehicles and the payloads.

Mr. Derbyshire at the Space Science Board Secretariat, has a number of reports from the exobiology subcommittee of the Space Science Board. These are, of course, transmitted to NASA in a formal way but I am sure that he would be happy to furnish additional copies and to be of any additional assistance possible.

I'm also sending a copy of this reply to Clark Randt in the new office of Life Sciences; we have, of course, been discussing some of these projects and that office should be instrumental in helping to get them underway.

Yours sincerely,

Joshua Lederberg
Professor of Genetics

CC: Dr. Clark Randt
Dr. Robert Jastrow